

# The SPEC-RG Reference Architecture For the Edge Continuum

Matthijs Jansen<sup>1</sup>, Auday Al-Dulaimy<sup>2</sup>, Alessandro V. Papadopoulos<sup>2</sup>, Animesh Trivedi<sup>1</sup>, Alexandru Iosup<sup>1</sup>

<sup>1</sup> Vrije Universiteit Amsterdam, Amsterdam, The Netherlands

<sup>2</sup> Mälardalen University, Västerås, Sweden



## 1 Context

- Computers are all around us: Smartphones, sensors, etc.
- These **endpoint devices** constantly generate data
- Data requires processing, but where?
  - Endpoint devices are **resource constrained**
  - **Offload to cloud**: High latency, privacy issues
- **Solution**: Process data close to the data source on decentralized, heterogeneous and mobile **edge devices**

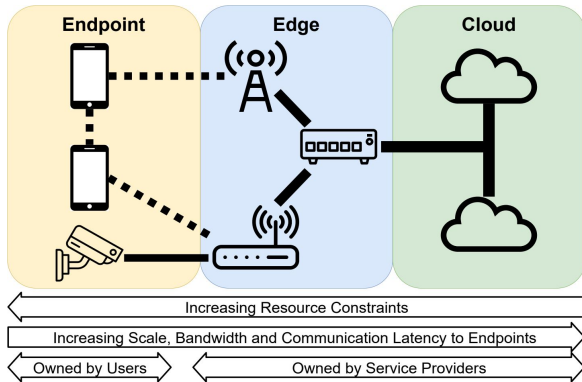


Fig. 1: Overview of the edge continuum

## 4 Utility

- Demonstrate the **utility of the architecture**
- Emulate 100s of cloud, edge, and endpoint devices through **virtual machines and networks**
- **Benchmark resource managers** (e.g., Kubernetes)

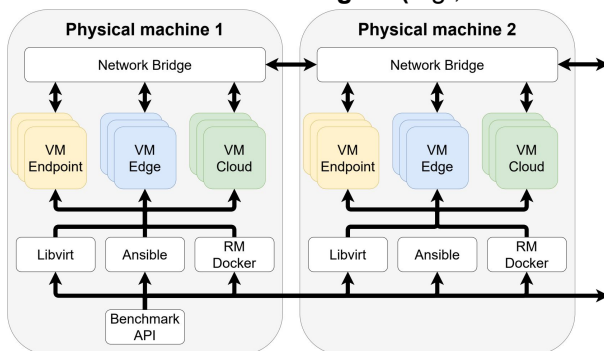


Fig. 3: Framework design

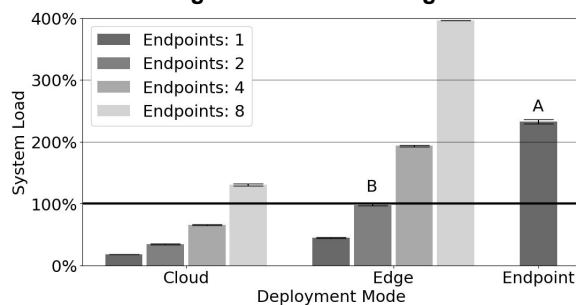


Fig. 4: System load, with an increasing number of endpoints connected to a cloud or edge worker

## 2 Problem

- The concept of **edge is new**
- How to use the edge is not well-defined
- Many computing models exist that combine cloud, edge, and endpoint devices: **Mobile crowdsourcing, (multi-access) edge computing, fog computing, etc.**
- These models all have their own abstractions, APIs, thus creating a general confusion regarding **what is edge computing**, and **what should a developer or infrastructure provider know about it**

## 3 Solution

- Survey computing models and find similarities
- Use these similarities to construct a **unified reference architecture for the edge continuum**

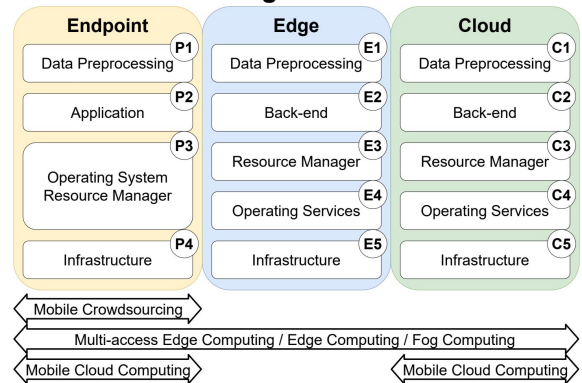


Fig. 2: Edge continuum reference architecture

## 5 Prediction

- Construct an **analytical performance model**
- Based on our benchmark results
- **Predict if offloading is feasible**

$$Local = \begin{cases} 0 & \text{if } \frac{T_{proc}}{C_e \times Q_e} > P \\ 1 & \text{otherwise} \end{cases}$$

$$Offload = \begin{cases} 0 & \text{if } \frac{T_{proc} \times E}{C_o \times Q_o} > P \\ 0 & \text{if } \frac{T_{pre}}{C_e \times Q_e} > P \\ 0 & \text{if } D > B \\ 1 & \text{otherwise} \end{cases}$$

Fig 5: Performance model

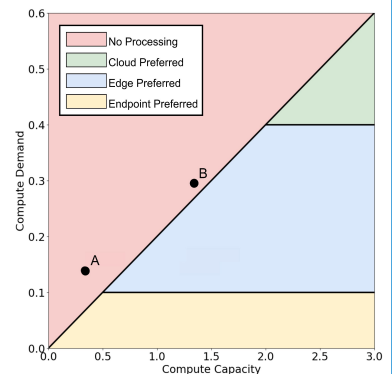


Fig. 6: Exploring preferred deployment models

